FINAL REMEDIAL INVESTIGATION/FEASIBILITY STUDY
WHATCOM WATERWAY SITE
BELLINGHAM, WASHINGTON

1.0 EXECUTIVE SUMMARY

The Whatcom Waterway Area (WW Area) consists of intertidal and subtidal aquatic lands within and adjacent to the Whatcom and I&J Street Waterways in Bellingham, Washington (Figures 1-1 and 1-2). Mercury has historically been detected in sediment samples collected within this area at concentrations that exceed state Sediment Management Standards (SMS) chemical criteria.

The Bellingham Bay Demonstration Pilot Project (Pilot Project), which encompasses the WW Area as well as other sediment cleanup sites in Bellingham, is an initiative of the Cooperative Sediment Management Program. The Pilot Team is made up of 15 federal, state, and local entities addressing and coordinating contaminated sediment cleanup needs with other key management issues in Puget Sound. The Pilot Project was designed to expand opportunities for achieving multiple goals in Bellingham Bay, including source control, sediment cleanup, sediment disposal, habitat restoration, and aquatic land use elements.

Working under the oversight of the Washington Department of Ecology (Ecology) and other Pilot Project participants, Georgia-Pacific West, Inc. (G-P) performed a detailed remedial investigation/feasibility study (RI/FS) of the site. The study provided data, analysis, and engineering evaluations to develop and evaluate a set of feasible cleanup alternatives for the WW Area. This WW Area RI/FS, coupled with the Bellingham Bay Comprehensive Strategy Environmental Impact Statement (EIS), will be used by the Pilot Team to select a preferred alternative. As a member of the Pilot Team, Ecology will make a regulatory selection consistent with the consensus opinion of the Pilot Team.

Ecology approved G-P's cleanup study plan in August 1996. The Draft Remedial Investigation (RI) Report containing the results of physical, chemical, and biological testing was submitted to Ecology in May 1997. In June 1997 and again in October 1998, additional sediment sampling and analysis was added to the RI/FS. The draft final RI/FS Report was issued in July 1999 for public comment, concurrent with the Comprehensive Strategy EIS. This final RI/FS Report presents the integrated results of all sampling and analysis, along with evaluations of sediment site units, cleanup technologies, and detailed evaluations of remediation alternatives. The report presents information relevant to the weighing of alternative actions considering net environmental benefits, permanence, implementability, cost, and other SMS and Model Toxics Control Act (MTCA) criteria.

This RI/FS Report is intended to facilitate agency, landowner, and public review, and to enable Ecology and the Pilot Project to select an appropriate cleanup action alternative for the WW Area. The Pilot Project has developed a Comprehensive Strategy that integrates bay-wide source control, sediment cleanup, sediment disposal, habitat restoration, and aquatic land use elements into a coordinated approach. In the EIS, the environmental consequences of implementing the Comprehensive Strategy, including the sediment remediation alternatives presented herein, are analyzed. This RI/FS is a companion document to the EIS.

1.1 Summary of Existing Conditions

Major findings of the study are summarized below:

- **Sediment Thickness**. The typical thickness of non-native sediments (i.e., those deposited after initial channel dredging, and which contained detectable chemical constituents), ranged from two feet below the mudline within inner Bellingham Bay (including the outer Whatcom Waterway federal navigation channel), to more than 10 feet near the head of the Waterway.

- **Sediment Quality.** Of the more than 50 chemicals analyzed, only three were regularly detected at concentrations that exceeded current state Sediment Quality Standard (SQS) chemical criteria. These chemicals of potential concern included mercury, 4-methylphenol, and phenol. Accumulations of wood material exceeding 50 percent by volume were also identified within the WW Area, and were often associated with elevated 4-methylphenol and phenol concentrations.

  Surface sediment concentrations of mercury, 4-methylphenol, and wood material in the WW Area were significantly lower than concentrations detected several feet below the mudline. These patterns correspond to decreasing surface sediment concentrations over the past 25 years, which in turn is attributed to source controls implemented at the G-P facility and in other areas of inner Bellingham Bay beginning in the early 1970s. This process, referred to as natural recovery, is also driven by the gradual incorporation of clean sediments deposited in the area, primarily from the Nooksack River. Continuing wood material degradation processes appear to affect the distribution of 4-methylphenol and phenol concentrations at the site.

- **Sediment Toxicity.** Over the 1996 to 1998 period, sediment samples from 40 site locations were submitted for confirmatory biological testing to verify or refute sediment toxicity predicted on the basis of sediment chemical concentrations. Sixty percent of these samples (collected from 24 locations) were determined to be non-toxic (i.e., did not exceed SQS minor biological effects criteria). The remaining 40 percent of the

locations exceeded SQS minor adverse biological effects criteria. Fifteen percent (6 locations) exceeded Ecology's minimum cleanup level (MCUL) based on more than minor biological effects. Sediment toxicity was not correlated with mercury or with other chemical parameters.

Most of the surface sediments located within the Whatcom Waterway navigation channel did not exceed SQS biological effects criteria, even though underlying subsurface sediments within the channel contained some of the highest concentrations of mercury, 4-methylphenol, and wood material detected at the site. These data confirm the protectiveness of the natural sediment cap that has formed in the channel as the result of source controls and natural recovery, and concurrent with active navigation use of the channel.

Sediments exceeding SQS biological effects criteria were restricted to a small portion of the Whatcom Waterway near the head of the navigation channel, along with nearshore areas adjacent to the navigation channel, and the former Starr Rock sediment disposal site. Sediments exceeding MCUL biological effects criteria were more localized, restricted to several nearshore areas immediately adjacent to G-P's Aerated Stabilization Basin (ASB), and to one sample near Starr Rock. The areal extent of biological effects was significantly smaller than that represented by sediment chemistry.

- **Bioaccumulation.** In addition to ecological risks, bioaccumulation of mercury in certain fish and shellfish populations within inner Bellingham Bay (e.g., Dungeness crab caught within the Whatcom Waterway) may also have potential human health implications. Tissue mercury concentrations within the WW Area are currently elevated as much as three times above regional background levels. However, even the maximum tissue concentrations reported in this area are below conservative benchmark concentrations calculated to protect tribal fishers and sensitive wildlife that may consume relatively large amounts of seafood.

  In order to address the potential for localized exposures, a sediment screening level was developed for mercury that is conservatively protective of potential bioaccumulation risks to human health and to high trophic level wildlife receptors. The screening level utilized the observed relationship between tissue concentrations and surface sediment concentrations within the sampled species' home range. Using screening-level risk assessment methods, a conservative tissue benchmark mercury level was calculated to protect tribal fishers and wildlife that may consume relatively large amounts of seafood from Bellingham Bay. The sediment screening level determined using these methods was 1.2 milligrams per kilogram (mg/kg; dry weight basis). For the WW Area, sediments exceeding this health-based screening level generally corresponded to those areas of the site also targeted for cleanup to address sediment toxicity concerns.

- **Source Control.** Detailed sampling and analysis of more than ten potential contaminant sources in inner Bellingham Bay was undertaken as a part of this RI/FS. No ongoing, significant sources of mercury were identified within the WW Area that have the potential to recontaminate sediments. Although ongoing urban stormwater inputs of 4-methylphenol and phenol have been documented in the area, these sources appear to affect only a relatively small area surrounding two stormwater outfalls in the WW Area. Moreover, the available data suggest that sediment concentrations of phenol and 4-methylphenol are more closely associated with the degradation of historical wood material deposits. Cleanup of WW Areas to address sediment toxicity concerns would likely alleviate this "internal" source of 4-methylphenol and phenol.

  Low-level mercury concentrations have been detected in shallow groundwater adjacent to the G-P Log Pond. Shoreline seepage may contain similar or lower concentrations due to tidal mixing and chemical attenuation. Although the low rate of groundwater mercury loading to the Log Pond does not appear sufficient to result in sediment recontamination, control of potential seepage releases to the G-P Log Pond is nevertheless being addressed as a component of this RI/FS. G-P is also planning further mercury controls as part of forthcoming chlor-alkali facility closure actions.

1.2 Development of Remedial Action Alternatives

For the purpose of developing and evaluating appropriate remedial action alternatives, the WW Area was differentiated into site sediment units with unique physical, chemical, biological, and site use characteristics. For example, site units with water depths that are compliant with the federally authorized channel depths were differentiated from units that have shoaled to less than the authorized depths. Comparisons with authorized channel depths and future maintenance dredging projects considered a typical overdredge allowance of two feet.

As part of initial development of sediment remediation alternatives for the WW Area, general response actions were identified and screened, cleanup technologies were assessed, and various process options incorporated to develop a reasonable range of remedial alternatives, consistent with SMS guidance. The identification, screening, and assembly of cleanup technologies into bay-wide alternatives followed direction provided by the Pilot Project, and included additional site-specific remedial alternatives developed by G-P.

Three response action categories were evaluated in this RI/FS: source control/natural recovery; containment; and treatment. Although several existing treatment technologies are feasible, the potential implementability

and effectiveness on various types of contaminants and volumes of sediment is uncertain. Specifically, the high sediment volumes and low contaminant concentrations characteristic of the WW Area may be difficult to address using available treatment technologies. In addition, many of the available "treatment" technologies do not remove, concentrate or recover mercury, but rather alter the sediment containing the mercury. Studies are underway by various state and federal agencies to assess production, cost and effectiveness aspects of the more promising treatment technologies. These studies should provide a more refined determination of the practicability of sediment treatment for WW Area sediments. Nevertheless, because of current implementability and effectiveness uncertainties, treatment of sediments was not carried forward into the detailed RI/FS analysis of remediation alternatives.

Consistent with SMS guidance, remedial technologies including source control/natural recovery, *in situ* containment (capping) and *ex situ* containment (removal and disposal) were assessed for possible application to the WW Area. All of these technologies are capable of addressing the volumes and contaminant levels observed at the WW Area, and were therefore carried forward into the detailed analysis of remediation alternatives.

Source controls and natural recovery of sediments in the WW Area have been well documented by the historical record of declining surface concentrations of mercury over the past 25 years. These declines were corroborated with detailed mathematical modeling of natural recovery processes performed for this RI/FS. The RI/FS analyses indicated that most (more than 80 percent) of those WW areas that currently exceed SQS criteria will recover to below prospective SQS criteria (incorporating confirmatory biological monitoring as appropriate) by the year 2005.

However, based on conservative modeling assumptions, three sediment site units may not recover within the next 10 years to below SQS criteria. These areas are: 1) the G-P Log Pond; 2) nearshore areas located adjacent to the Whatcom Waterway, immediately offshore of the G-P Aerated Stabilization Basin (ASB); and 3) the former Starr Rock sediment disposal site. All three of these areas contained the highest mercury and wood material concentrations reported within inner Bellingham Bay, and also encompass most of the areas that currently (1996 to 1998 sampling) exceed Ecology's MCUL based on biological effects.

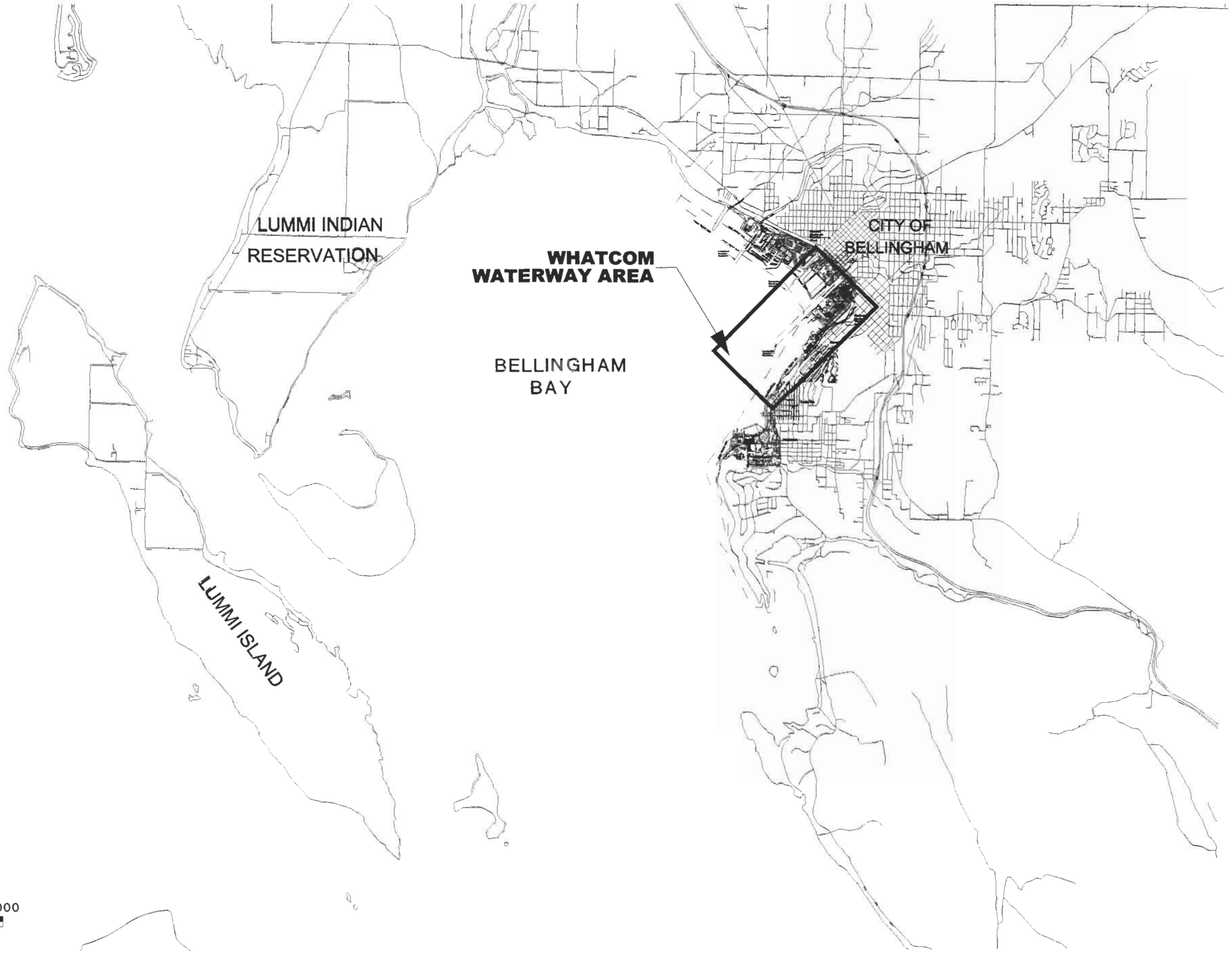
With the exception of the no action (baseline) alternative, all of the cleanup alternatives carried forward for detailed analysis in this RI/FS included either *in situ* containment (capping) and/or removal of these three priority sediment cleanup areas. Removal process options evaluated in this FS include mechanical and hydraulic dredging. Mechanical methods were found to be more practicable for the WW Area.

The disposal options evaluated include upland, nearshore, and contained aquatic disposal (CAD), incorporating the "short list" of high priority disposal sites identified by the Pilot Project (BBWG, 1998b). A review of key technical considerations relevant to application of these technologies and process options within the WW Area is included in this RI/FS. This review includes considerations for short- and long-term water quality impacts, disposal site stability, habitat considerations, and navigation dredging requirements. Key technical considerations identified from this review were incorporated into the development of the site-specific remedial alternatives.

For the purpose of this RI/FS, a total of 9 sediment remediation alternatives were evaluated that represent a wide range of potentially appropriate remedial technologies and process options. These alternatives include different combinations of natural recovery, capping, removal, and disposal. The majority of the alternatives were developed by the Pilot Project, with the balance being developed independently by G-P. When viewed together, the alternatives present the broad range of potential remediation, habitat enhancement, and land use options available within the WW Area, and highlight tradeoffs associated with implementation of different alternatives, consistent with SMS and Pilot Project objectives.

1.3 Identification of a Preferred Alternative

Through the MTCA Cleanup Action Plan and EIS processes, a preferred bay-wide sediment remediation alternative will be identified. It is important to note that, in the absence of the Pilot Project effort, the preferred sediment remediation alternative for the WW Area would necessarily focus only on statutory selection criteria set forth in the SMS. In consideration of the statutory criteria comparisons, as summarized in this RI/FS, the likely recommendations for WW Area sediment remediation would include elements of further source controls, short-term natural recovery, capping, and limited dredging. The site-specific alternatives incorporating these technologies and process options are consistent with SMS selection factors and comply with statutory requirements. However, as discussed above, the Pilot Project will identify a preferred sediment remediation alternative that will achieve multiple goals including habitat restoration and land use actions in an effective, cost-efficient way. It is Georgia-Pacific's belief that the best course of action is to not identify a preferred alternative and defer to the Pilot Project. From a regulatory standpoint, Ecology will ultimately select the remedy for the Whatcom Waterway Site.



ANCHOR ENVIRONMENTAL, L.L.C.

Date: 07/15/99 fig2-1.dwg

Figure 1-1
Vicinity Map
Whatcom Waterway Area

BELLINGHAM BAY

'STARR ROCK' DISPOSAL SITE

FORMER WHATCOM WATERWAY SEDIMENT DISPOSAL 'MOUNDS'

I AND J STREET WATERWAY

BORNSTEIN'S SEAFOOD

HAWLEY'S MARINA

G-P AERATED STABILIZATION BASIN

ROEDER AVENUE LANDFILL

HOLLY STREET LANDFILL

FORMER OLIVINE SITE

ROEDER AVE.

HOLLY ST.

ASTOR ST.

WHATCOM CREEK

MARITIME HERITAGE CENTER PARK

WHATCOM WATERWAY

BNSF

LOG POND

FORMER BULKHEAD

PORT LOG RAFTING AREA

PORT OF BELLINGHAM

GEORGIA-PACIFIC PLANT

CHLOR/ALKALI PLANT

CORNWALL AVENUE LANDFILL

R. E. HALEY

AMERICAN FABRICATORS

CHEVRON

BMT

CORNWALL AVENUE

APPROXIMATE PROPERTY BOUNDARY LINE

EXISTING MUDLINE (CONTOUR INTERVAL 2')

ANCHOR ENVIRONMENTAL, L.L.C.

0 600

Scale in Feet

Date: 07/15/09 fig2-2r2.dwg

Figure 1-2
Project Area and Land Use Plan
Whatcom Waterway Area